

**68000 Sound Driver
Ver. 3.00**

Rex Sabio
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Introduction

The 64000 Sound Driver Version 3.00 (successor to "V2") is designed to fully exploit the sound source that is incorporated into the SUPER32X.

Sound Driver Specifications

The following are the specifications for the Sound Driver.

Target sound source	FM8 or 8-round/PSG tone 3+ noise (16bit A/D sound) PCM 6 sound (16bit linear or 32bit 4.16, 32bit stereo)
Required resources:	
Driver size (65000)	Approximately 3000H (including a 256 driver FCB)
Work size	Approximately 1800H
CPU load (64000)	
EDDL	Approximately 7%
Music-playing	Approximately 8%
(8 bit per channel)	Approximately 8.5%
CPU load (256)	100% (exclusive use)
Number of tracks	
Music	16 16 bytes frames with the PCM driver 1 track
Effects	A software envelope is provided via a PCOM. Two types of software effects tables are provided in an FMD532. These resources can be shared with other sound sources with the same "lock and load". A volume list can be created against the sound source.
etc.	If PCOM is not used, the driver uses decompress by approximately 1000.

Activating the Sound Driver

The following procedures are used to control the VINT.

- 1) Use a system call (mc000000h) to initialize the Sound work space
- 2) Call the starting address for the Sound Driver every V-INT (approximately 16 ms)

See the system call column later in this chapter for a method for requesting sound data.

Memory Map

The Sound Driver operates under the following memory map:

ROM memory map
Sound Driver (approximately 3000H)
Sound Driver subsystem
Data sectors (offset address) (400 bytes)
PCM area (uninitialised)
PPM data (uninitialised)
Mono data (uninitialised)
ME data (uninitialised)
Table envelope data (uninitialised, in units of 100H bytes)
Table volume data (uninitialised, in units of 100H bytes)
Rhythmic note data (uninitialised, in units of 8 bytes)
FM sound source data (uninitialised, in units of 100 bytes)

RAM Memory Map

Common note queue (10, 10H bytes with the number of PCM channels preloaded)
Channel workspace (both 16 pointers for all voices and 100H X 10H word bytes (2000H bytes))

Fill-In Data

The Driver is filled with the following information at a distance of 0CH from the starting address:

Moving	Size
Work space moving volume	4 bytes
Work space size	4 bytes
PCM (pos. 00H note 10H layer 00H data)	1 byte
Number of sounds generated from the PCM sound source	1 byte
Number of sounds generated from the PM sound source	1 byte
Number of sounds generated from the PSG sound source	1 byte
Number of sounds generated from the FM sound source	1 byte
Total number of tracks	1 byte
Total number of tracks per music	1 byte
Total number of tracks per SIE	1 byte
Driver version number	4 bytes
Driver type	4 bytes

System Calls

The V3 uses system calls to support driver controls. This enables the V3 to accommodate driver version upgrades, as well as work-space changes, without requiring a modification of the V3 itself. Although it is possible to control the driver by directly rewriting the work space, as has been done in the past, to provide for future version upgrades it is recommended that the driver be controlled by means of system calls.

List of System Calls

Number	Operation	Input register	Output register	Destroyed register
00H	Indicate the Sound work space and the surfaces around the Sound Cover	D1	None	None
01H	Requests a piece of space	D1	None	D0/A0
02H	Requests an EC	D1	None	D0/A0
03H	Sends a base-table	D1	None	None
04H	Gets the music master volume	D1	None	None
05H	Gets the SB master volume	D1	None	None
06H	Gets the mixer master volume	D1	None	None
07H	Gets the DE master volume	D1	None	None
08H	Set a phase	None	None	None
09H	Registers/Unregs.	None	None	None
0AH	Writes communication data	D1	None	None
0BH	Reads communication data	None	D1	None
0CH	Requests to stop the driver	None	None	D0/A0

SHH	Requests to stop the car.	None	None	None
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Details on System Calls

First, set the desired system call number in the register C0. Then, set register values as necessary, and call the address that is obtained by adding 8 to the starting address of the Sound Driver.

- 00H Initializing the Sound Driver and the hardware around the Sound Driver Function:** Initialize the Sound Driver and the hardware around the Sound Driver.
Input: D0b .. 00H
D1b .. sets NTSC/PAL
0 .. sets to NTSC
1 .. sets to PAL
Output:
Destruction:
Remarks:
- 01H Requesting a piece of music**
Function: Perform music
Input: D0b .. 00H
D1b .. piece number
Output:
Destruction:
Remarks: D0/A0
Because of a 4-byte request buffer, sounds can be produced in a maximum of four simultaneous interrupts (common to the SE number). Some request numbers can cause the SE to be performed (music numbers are not checked).
- 02H Requesting an SE**
Function: Progess SE sounds
Input: D0b .. 00H
D1b .. SE number
Output:
Destruction:
Remarks: D0/A0
Because of a 4-byte request buffer, sounds can be produced in a maximum of four simultaneous interrupts (common to the music piece number). Some request numbers can cause music to be performed (music numbers are not checked).
- 03H Fade-request**
Function: Sets the fade-in/out option.
Input: D0b .. 00H
D1w .. sets the fade value

08-000	1-000
Fading depth	Fading speed

- Output:**
Destruction:
Remarks: Fader-in operations can be performed by setting the fading depth to a negative number (2's complement). The allowable range of fading speed is 00H-7FH (in units of V-int).
- 04H Setting the master master volume**
Function: Sets the volume for the entire music.
Input: D0h .. 0FH
D1h .. volume
Output:
Destruction:
Remarks: The allowable range of volumes is 00H-7FH, where 00H indicates the maximum volume, and 7FH the mute option.
- 05H Setting the master SE volume**
Function: Sets the volume for the entire SE.
Input: D0h .. 0FH
D1h .. volume
Output:
Destruction:
Remarks: The allowable range of volume is 00H-7FH, where 00H indicates the maximum volume, and 7FH the mute option.
- 06H Setting the master master transpose**
Function: Transposes the entire music.
Input: D0h .. 0FH
D1h .. transposition value
Output:
Destruction:
Remarks: A transposition value can be a negative value (2's complement).
- 07H Setting the master SE transpose**
Function: Transposes the entire SE.
Input: D0h .. 0FH
D1h .. transposition value
Output:
Destruction:

	Remarks: A transposition value can be a negative value (-2 complement)
08H	Requesting a pause Function: Sets a pause. Input: D0b ... D8H Output: Destruction: Remarks: Because PWM sound sources lack a function for stopping sound production on a channel-by-channel basis, once sound production is started it cannot be stopped.
09H	Resetting a pause Function: Resets a pause. Input: D0b ... D9H Output: Destruction: Remarks:
DAH	Writing communication data Function: Writes communication data from sound work space. Input: D0b ... DAH D1b ... data Output: Destruction: Remarks: This is a processing action viewed from the main system. Currently data cannot be read on the Driver. Therefore, writing data from the main system will not alter the processing.
0BH	Reading communication data Function: Reads communication data from sound work space. Input: D0b ... DBH D0b ... data Output: Destruction: Remarks: This is a processing action viewed from the main system.
0CH	Requesting to stop music Function: Terminates music. Input: D0b ... XC8 Output: Destruction: Remarks: Because PWM sound sources lack a function for stopping sound production on a channel-by-channel

basis, once sound production is started it cannot be stopped.

0DH Requesting to stop an SE

Function Terminates an SE

Input

D0H - 0DH

Output

Destruction

Remarks

Because PWM sound sources lack a function for stopping sound production on a channel-by-channel basis, once sound production is started it cannot be stopped.

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Data Request Numbers

For various pieces of data (tracks and SIDs), the following range of request numbers can be specified:

Mode	RE
000-07H	21H-FFH

The following effect commands can be requested:

Number	Effect name	Effect
00H	Flute-in	Produces a flute-in effect.
01H	Flute-out	Produces a flute-out effect.
02H	Note	Stops the instruments played.
03H	Stopping SID	Stops all SID's from when sound file being produced.
04H	Pausing	Pauses music.
05H	Resuming a pause	Resumes music from a pause state.
06H	Music master transposing up	Raises the music master transposition by a halftone.
07H	Music master transposing down	Lowers the music master transposition by a halftone.
08H	SID master transposing up	Raises the SID's master transposition by a halftone.
09H	SID master transposing down	Lowers the SID's master transposition by a halftone.
0AH	Music master volume up	Increases the master volume for music by 1.
0BH	Music master volume down	Reduces the master volume for music by 1.
0CH	SID master volume up	Increases the master volume for the SID by 1.
0DH	SID master volume down	Reduces the master volume for the SID by 1.
0EH-FFH	Sound Driver vibration	Initiating the Sound Driver.

Sound Data

This section describes the internal structure of sound data. For address specification, the term "address" refers to a relative address from the starting address shown in the following table.

Top Vector

A top vector stores an offset address of data (4 bytes per address)

Address of PCM information
Address of the PWM information table
Address of SE information
Address of the SC information table
Address of table envelope data
Address of table volume data
Address of FM rhythm lot data
Address of FM sound source timbre data

Address Tables

An address table is contained in PCM, PWM, SE and in an SC, and in one place stores the addresses that point to those pieces of information (envelope addresses and size information in the case of PCM), tempo information and track addresses in the case of music).

PCM Data

PCM data stores addresses for PCM information. Any two-byte data relating to PCM is stored in terms of single-address (UNKNOWN/DRUM) - UNKNOWN TERM).

Playback speed (simply a 280-weight value, not a sampling rate) (1 byte)

Parameter for playback (1 byte)
Address of playback memory (4 bytes)
Data size (2 bytes)

Music Information Data

This data codes the information necessary for playing back a piece of music (tempo, address to sequence data).

MTG/PAL tempo (in the order of MTG and PAL), 21 x 2 bytes
Address of PCM sound source/SCN sequence data, 2 bytes

PCM sound source 0CH, master transport II [bytes]
PCM sound source 0CH, master volume [1 bytes]
PCM sound source 1CH, by direct selection [1 bytes]
JTM sound sources 0-S [TM SCM currently not available] [160 bytes]
POL sound sources 2-3+1 [use channels] [164 bytes]
PWM sound sources 0-3 [3x4 bytes]

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SE Information

This field provides the data (number of required channels, etc.) necessary for producing SE sounds.

Number of required channels (1 byte)
Priority (1 byte)
Sound source ID for track 0 ("0") [2 bytes]
Sequence data address for track 0 [2 bytes]
Transpose for track 0 (1 byte)
Volume level for track 0 (1 byte)

PD See the section on "Identifying sound sources".

Table Vibrato/Table Envelope

These tables require a minimum size of 100H per table (page). Both data and continuations are coded in numerical values. Vibrato data is expressed in 2's complements as 7FH (maximum positive number), +0FH (neutral), and -03H (maximum negative number). Only the values 00H-7FH can be used in an envelope. Continuations are expressed in 80H-84H as indicated below:

Number	Function
00H	Return to the beginning of the page
01H	Resets the last value
02H	Moves to the next data position
03H	Transitions between the sound generation table and the next position. The previous address is lost after generation control.

PM Drum Kit

The data sequence number is used as a key number during sequencing.

Offset	Parameter name
00H	Timbre number
01H	Volume
02H	Mixing interval

00H	Port no.
01H	Table voice number
02H-07H	Volume square

FM Sound Source Parameters

FM sound source timer data is in a partially packed format so that it can be written directly into a register.

Offset	Parameter name
00H	CorrectionFeedback
01H	Center/Multistep (bits 1, 3, 2, 4)
02H	Key Scaling/Attack Rate (bits 0/0001, 1, 2, 3, 4)
03H	AM Decay Rate (bits 1, 3, 2, 4)
04H	Sustain Rate (bits 1, 3, 2, 4)
05H	Sustain Level/Hysteresis Rate (bits 1, 3, 2, 4)
1FH	Total Level (bits 1, 3, 2, 4)

Details of Sequence Commands

The following sequence commands can be used in event and SEQ:

01H-7FH Tone length

Function: Sets the tone length. Given a musical interval, a sound can be produced solely on the basis of its length.

Remarks:

80H: Pause code

Function: Sets the pause code. Suspends reading data for a specified interval of time.

Remarks:

81H-BCH Scale (C,GM,D,D#E,F,F#G,G#A,A#B)

Function: Specifies a musical interval (pitch) range. Given a tone length, a sound can be produced solely on the basis of its musical interval.

Remarks:

C0H, data.b

Function:
Remarks:

Writes communication data.

C1H, number.b

Function:
Remarks:

Requests an SR.

C2H offset.b, byte-count, data.b

Function:
Remarks:

Writes a specified byte count bytes offset for a specified sound workspace.

The SoundDriver does not provide for malfunction that may occur as a result of using this command to rewrite the work space.

C3H, number.b

Function:
Remarks:

Sets the FM sound source envelope to the SFC type.
For details, see the "FM-2632 Application Manual".

C4H, PMS/AMS data.b

Function:
Remarks:

Sets a PMS/AMS

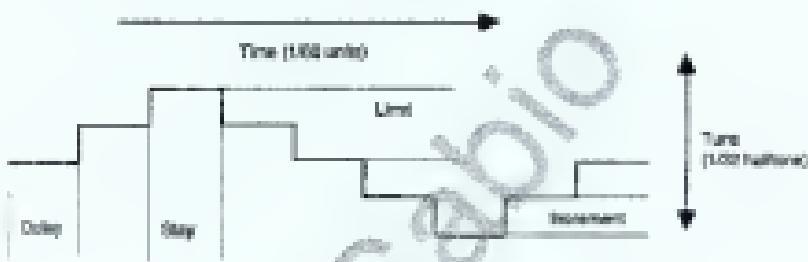
C5H, bank.b, register-number.b, data.b

Function:

Directly operates the register for an FM sound source.

Remarks	For details, see the "YM-2612 Application Manual". The Sound Driver does not provide for malfunction that may occur as a result of using this command to overwrite the work space.							
DH, mode b								
Function	Changes FM source sound production methods. The 0 mode is the ordinary sound production mode, the non-0 mode is the DRUM mode.							
Remarks	For a description of the DRUM mode, see the "Tone Editor Manual".							
DH-DFH								
Function	Sets the velocity.							
Remarks	Velocities are converted as shown below and added to the sound volume (length).							
Command codes	DH	01H	02H	03H	04H	05H	06H	07H
Actual value	30H	31H	32H	33H	34H	35H	36H	37H
Command number	0AH	0BH	0AH	0C0H	0D0H	0DH	0EH	0FH
Actual value	10H	11H	12H	13H	14H	15H	16H	17H
D0H, number b								
Function	Changes tremolo and envelopes.							
Remarks								
E1H, absolute-volume b								
Function	Sets the absolute volume. The higher the numerical value, the louder the volume.							
Remarks	The absolute volume is specified in a 00H-7FH range for all sound sources.							
E2H, relative-volume b								
Function	Sets the relative volume. The higher the numerical value, the louder the volume.							
Remarks	The absolute volume is specified in a 00H-7FH range for all sound sources. The function does not check for an overflow.							
E3H, point b								
Function	Sets the panpot. If the Qsound is used on a PWM sound source, the commands sets a Qsound point in MIDI-standard-based numerical values (00H-4015-7FH).							

Remarks:	This command is applicable only to FM and PWFM sound sources.
E4H, time b: Function: Remarks:	Sets the distance option in units of 1/32 halves.
ESH, delay b, stay b, increment b, limit b: Function: Remarks:	After a sound is produced, waits for a time interval equal to a delay interrupt, adds the increment for each stay, and changes the sign when the limit is reached.



ESH, transpose b Function: Remarks:	Performs a transpose. Negative values (2's complements) can also be used in this command.
E7H, bend-value w Function: Remarks:	Performs a bend. Actually, the bending operation is the 16-bit version of the detuning operation. Because of a 3-bit left shift that is performed internally, the actual resolution is 17 bits.
ESH, number b Function: Remarks:	Sets the table vibrato. The 0 value specified in the number field resets the vibrato.
ESH, switch b Function: Remarks:	Temporarily mutes the vibrato. An 0 reset and a non-zero sets the vibrato. This command is required in order to enable the commands ESH/E8H.

SAH, octaveb Function: Remarks:	Sets the octave to an absolute value.
SBH, octaveb Function: Remarks:	Increases the octave by one. Does not check for an overflow.
SCH, octaveb Function: Remarks:	Decreases the octave by one. Does not check for an overflow.
SBH, mode b [data] Function:	This command performs different operations, depending on the sound source selected, as follows

Sound source	Operation	Data type: count
FM sound source (SOH)	Sets the sound effect mode. Specifically, the immediate value to be written to the register followed by a block of memory (2 bytes per SOH).	8 bytes
FM sound source (SOH)	Allows you to specify whether it is allowed to be used as a PCMU or FM sound source. Specifically, the immediate value to be written to the register.	1 byte
PCM sound source	Sets a tempo. Sets the immediate value as the constant to the register.	1 byte
PWM sound source	Specifies the Osc1 and Osc2 parts of the Oscillators, a tempo value, and a volume.	1 byte

Remarks: Refer to the respective sound source manuals.

PDH, NTSCW, PALW Function: Remarks:	Sets the tempo. NTSC stores the value determined according to the following formula: $(\text{Tempo}/100) \times 512 + (\text{remainder of tempo}/100) \times 8192/100$ The value of PAL is NTSC value $\times 6/5$ This command is not applicable to the SE (the tempo is fixed at 100).
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F1H Function:	Disables turning the next note off.
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Remarks	
F2H, gate,value is Function: Remarks:	Sets the gate.
F3H, address w/ Function: Remarks:	Stores the current address in a work space and moves it to a specified position. An address (including a header) is a relative value from the beginning of music data.
F4H Function: Remarks:	Moves a given address to a stored address, discarding the stored address. Fetches addresses on a first-in, first-out basis.
F5H-F7H, count#b Function: Remarks:	Moves to an address, specified by F2H-FD1, a specified number of times. This is a repeat function. There are three commands of this type. Consequently, a maximum of three nesting levels can be used.
F8H-FAH Function: Remarks:	Terminates the repeat group specified by F5H-F7H, and moves to the data following F5H-F7H.
FBH-FDH Function: Remarks:	Saves the starting repeat position. This command is meaningful only if used in conjunction with the commands F5H-F7H.
FEH Function: Remarks:	Saves the current address. This command is meaningful only if 1 is specified in F8H.
FFH, mode,b Function: Remarks:	This command indicates the end of track data. If a non-0 mode is in effect, control moves to the data following FEH. In the case of a scroll mode, use FEH to set a move-to point.

* This data is applicable only to the Denver. Not all data can be controlled by means of data that is based on the MIDI converter.

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Identifying Sound Sources

The following IDs are assigned to various sound sources:

Sound source	PFM0	PSM1	PSM2	PSM3	PSM4	PSM5	PSM6	PSM7	PSM8	PSM9	PSM10
Sound source	00H	01H	02H	03H	04H	05H	06H	07H	08H	09H	0AH
Sound source	PCM0	PCM1	PCM2	PCM3	PCM4	PCM5	PCM6				
Sound source	0BH	0CH	0DH	0EH	0FH	0AH	0BH				

Notes

The following ranges of data can be used as pseudo-Voices:

Name	Range	Remarks
Key	00H-7FH	For note data only (i.e., velocity and the note are set separately). Keys are defined according to music standards. Keys that cannot be implemented in hardware (e.g., Octave 1 and 8) cannot be played currently.
Volume	00H-7FH	The maximum allowable volume is 00H, the minimum 0FH. The sound couples a 16-bit register according to their hardware specifications regard the balancing of volume levels. In case of digital volumes other than the PSM sound source, a specified volume level cannot be produced because of hardware/binary limitations.
Timbre	00H-7FH	The timbre parameter is not applicable to PCM or PWM. For PMD, a timbre is treated as a software envelope function.
Pan-pot	00H-7FH	The allowable range of numeric values for the panpot category is based on MIDI standards. This range is not applicable to sound sources (i.e., PCM and PMD) that do not have a pan-pot due to hardware/software limitations.
Sound Driver address		Any address that is calculable by the system is allowed.
Sound work space	FF0000H	This is fixed (i.e., general rule), and cannot be modified.

Maximum number of sounds produced	15-16	This number varies with the particular PCM driver selected.
Number of SE tracks	8	This is fixed as a general rule, and cannot be modified.
Switching between FMW and DCA	-	Switching between FMW and DCA can be performed either by not writing any data at the FMW or by using the command ESE.
VHS-2012 write-in data bytes	200H	This is fixed as a general rule, and cannot be modified.

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